



# Eta Carinae in the context of the most massive stars: a dedication to Sveneric Johansson (1942-2008)



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# Sveneric Johansson (1942-2008)



- PhD at Lund University (1978), Sweden, with Prof. Bengt Edlén, *Spektroskopiska undersökningar av Fe II*'.
- Sabbatical at Goddard Space Flight Center (MD/USA) during 1987-88.
- Professor 1999 and founder of the Atomic Astrophysics group 2001 and the Edlén Laboratory at Lund Observatory.
- Classical atomic spectroscopist with an unusual feeling for atomic spectra and atomic structure, especially the iron group elements.

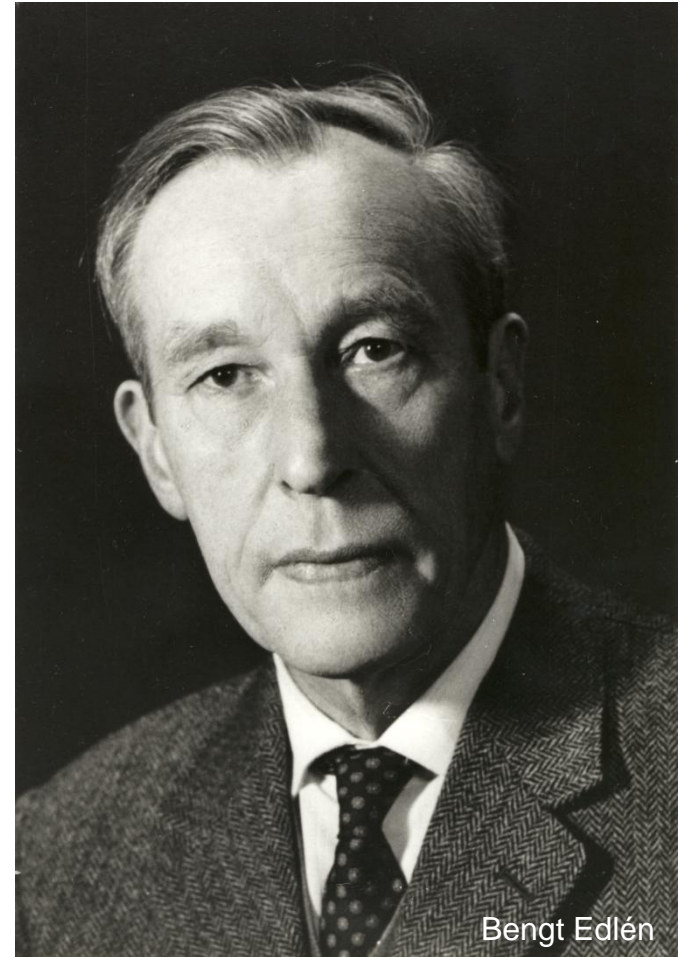


# Atomic Spectroscopists in history

Several major astronomical discoveries originate in laboratory investigations, performed for their intrinsic interest and not primarily aiming for a specific astrophysical problem.

- **Ira Bowen**, suggesting fluorescence (Bowen mechanism) in 1924 and identification of the first forbidden lines, [O III] in 1928.
- **Bengt Edlén**, Identification of highly ionized carbon, nitrogen and oxygen (e.g. C III, C IV, N IV, N V and O IV) in Wolf-Rayet stars.

He also identified the coronal lines with fine structure transitions in highly ionized iron group elements, e.g. FeX and Fe XI.



Bengt Edlén

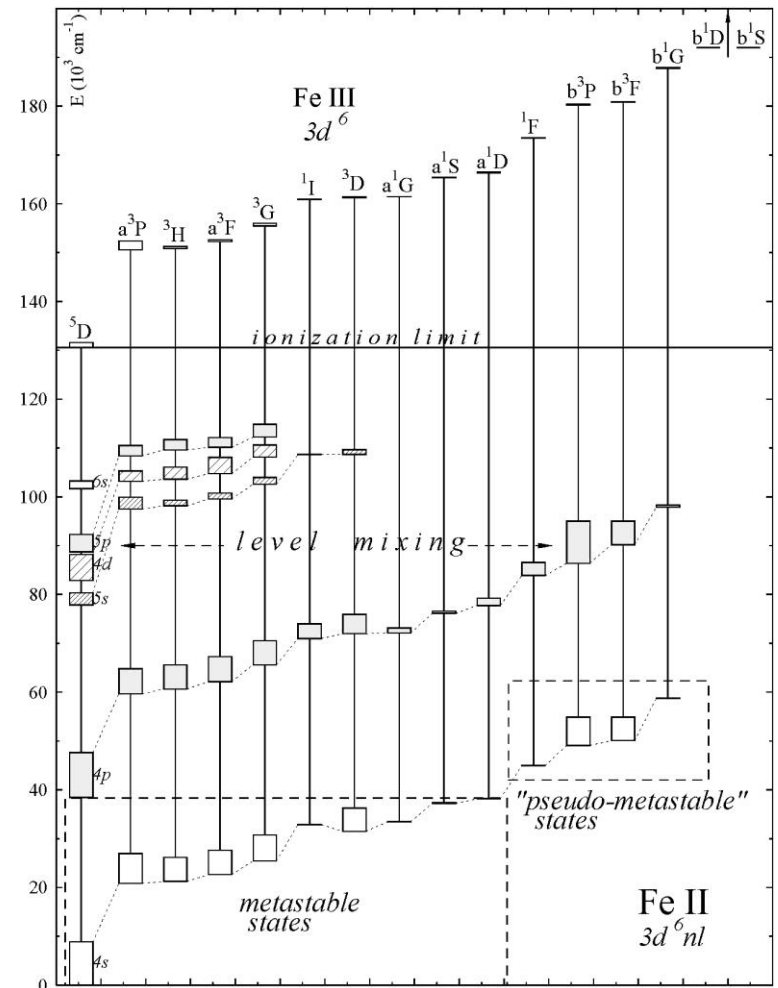
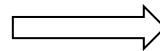
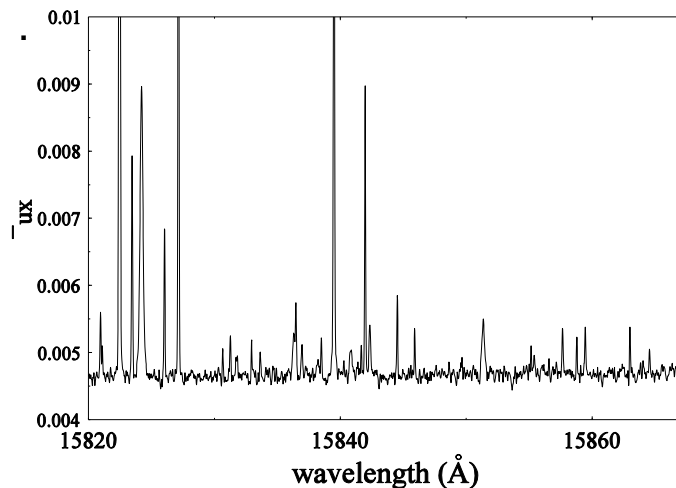
# Scientific achievements – term analysis

Skilful atomic spectroscopist with a feeling for term analysis.

Analyses on important iron group elements, primarily Fe II, but also, Sc II, Ti II, Cr II

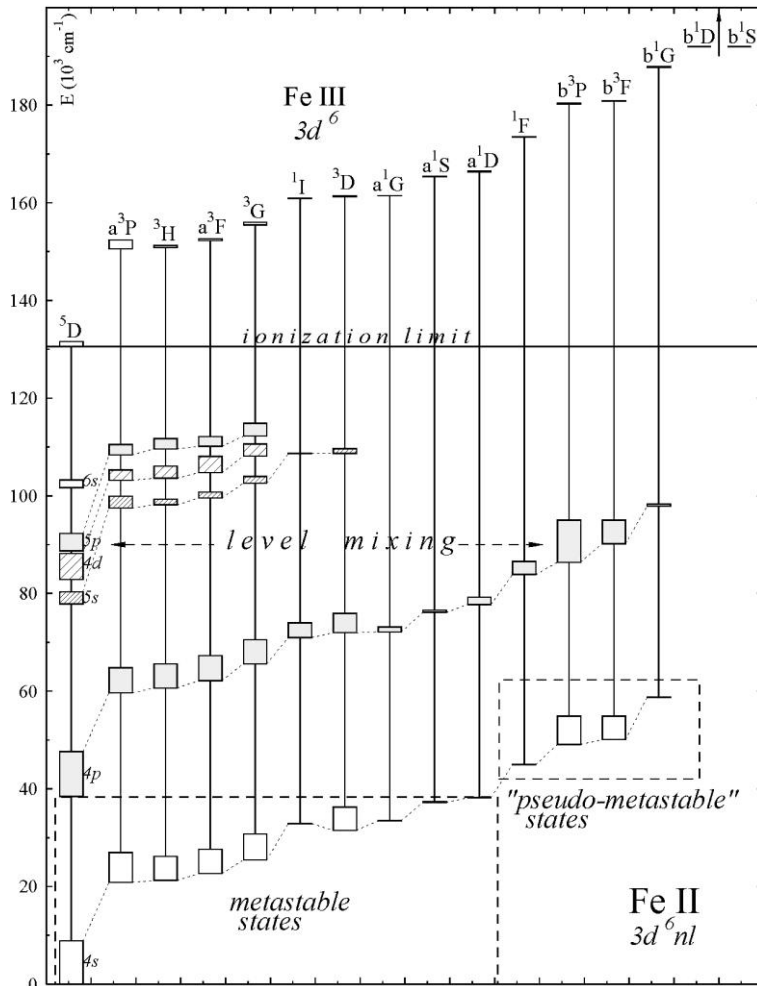
Early investigations in the near infrared wavelength range, in the 1970's

Later FTS measurements in UV-opt.





# Scientific achievements – term analysis of FeII



1972 given FeII as PhD project, but only investigations to 1  $\mu\text{m}$ , since longer wavelengths 'will never be observed by astronomers' (Edlén, 70's). 300 levels known by then.

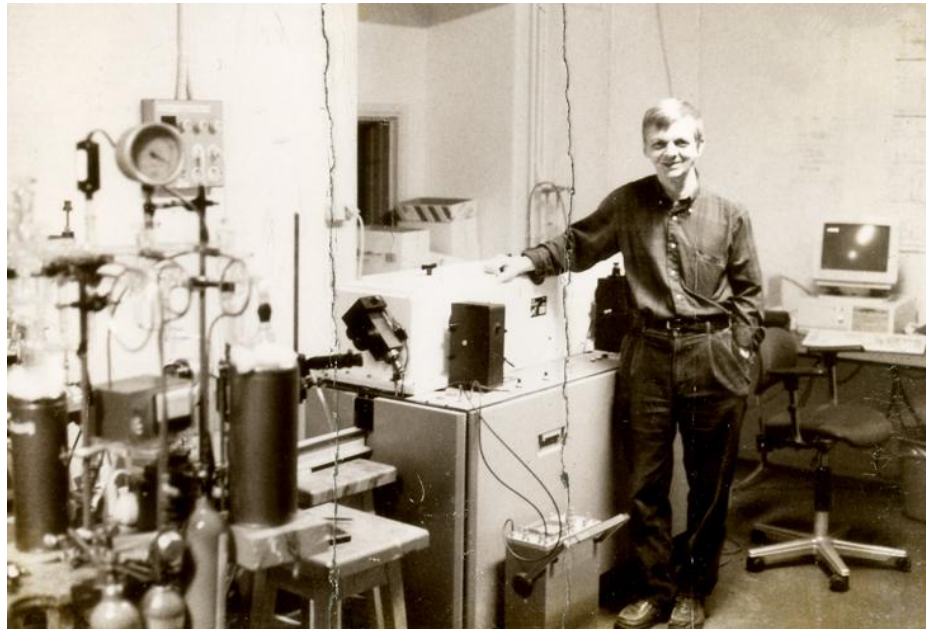
Over 1000 energy levels known (2009).

The last of these,  $3d^5(^5S)4s4f$ , were identified in the spectrum of HR6000, the first identified from a stellar spectrum.





# Scientific achievements – HST lab spectroscopy



Sveneric Johansson foresaw the need of high-resolution, high-accuracy atomic data in the UV with the upcoming HST.

Together with Dave Leckrone on the pathfinder project on  $\chi$  Lupi:  
Wavelengths, line profiles (isotopes) and line strengths.

Here seen with the Lund UV-FTS.



# Conference organiser

- Initiated the international triannual conference series:  
*Atomic Spectroscopy and Oscillator Strengths* (ASOS), first held in Lund 1983 and most recently in 2007 was held in memory to Svenerics retirement.
- Hosted the 'Eta Carinae and other mysterious stars' conference on Hven in 2000.





# Photoprocesses in astrophysical plasmas

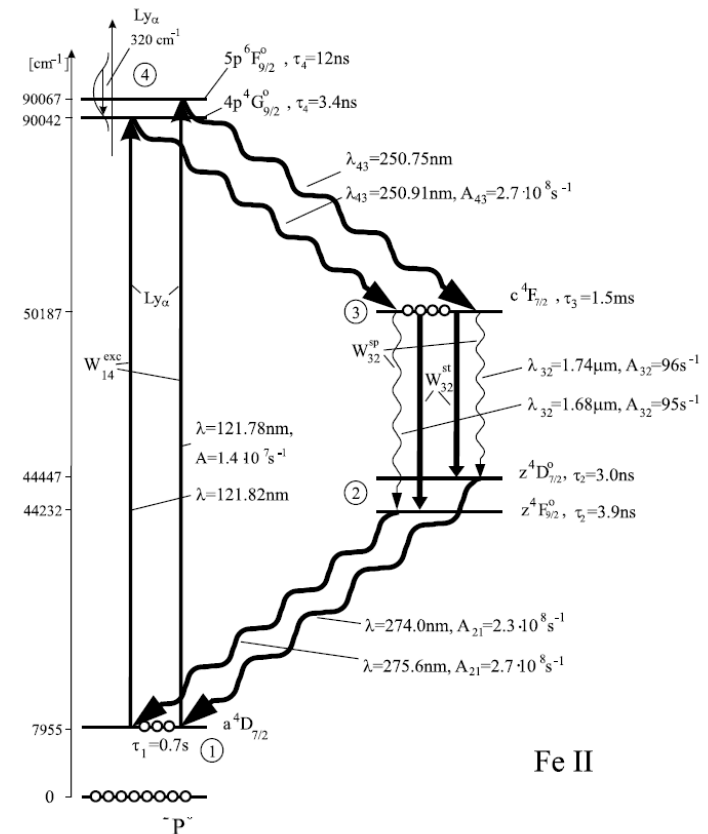
## applications to Eta Carinae ejecta



- Identification of fluorescence mechanism in symbiotic stars and stellar winds.
- Suggested stimulated emission in Fe II lines observed in Eta Carinae ejecta, based on line ratios in FeII UV lines at 2506/8 Å.

Johansson and Letokhov:

- Concept of Resonance Enhanced Two-Photon Ionization (RETPI) to explain the strengths and anomalous behaviour of spectral lines in the spectrum of Eta Carinae.
- LASER routes in FeII and other ions.



Fe II



# Vladilen Letokhov (1939-2009)

- Specialized in the field of atomic physics and laser theory. Early work of laser cooling and Bose-Einstein condensates.
- Head of Laser Spectroscopy Department, Troitsk, Moscow. Guest professor at several institutes.
- Almost 900 published papers, and 15 monographs.
- Most frequently cited Russian scientist in all fields 1973-1988. (ISI, 1990)



## In memoriam



Sveneric Johansson and Vladilen Letokhov sadly passed on during the last year. Their final publication '*Astrophysical Lasers*' was published earlier this year.

